

CHBE 670

Classical Papers for Science and Engineering

Short Title:

Classical Papers Sci. and Eng.

Course Number CHBE 670

Instructor: Dr. Marc Robert Email: robert@rice.edu Duncan Hall 2088

Course department: CHBE

Catalog Description -

Students are introduced to a selection of exceptional works which are classical and pioneering in numerous fields of pure and applied sciences.

Course Rationale -

This course is useful and inspirational to students majoring not only in chemical engineering, but in all fields of engineering and science.

Course Overview -

(Please see attached Syllabus)

Student Learning Outcomes –

All applications covered in the Syllabus (next page) will be learned and discussed critically in depth.

1. No course of this nature is offered at Rice. It appears to be a first.
2. The papers will be critically discussed, and homeworks will be given as both problems and projects, alone or in groups.
3. This critical approach will provide a stimulating and inspiring preparation of the students in their approach to their own research.

Work and Assessment: -

Grading:

Homework: 50%; weekly homework, on average 4 problems each, 2 of them pledged with allowed textbook and class notes.

Final exam 50%, oral and individual exam, allowed textbook and class notes.

A minimum of 65% of the total points is required to pass.

Course Overlap: - N/A

Instructor: Full Professor MarcRobert

Contact information mrobert@rice.edu

Office hours: by appointment

Course Overview (Syllabus): -

1. Sadi Carnot (France, 1824), Fourier (1830), Thermodynamics of heat transport
2. Riemann (Germany, 1851-1866) Mathematics, mathematical physics, fluid mechanics
3. van der Waals (Netherlands, Nobel physics prize 1910) Equation of state, fluid interface, surface tension
4. Planck (Germany, Nobel physics prize 1918) Quantum theory
5. Nernst (Germany, Nobel chemistry prize 1921), Einstein (Germany, Nobel physics prize 1921), Debye (Netherlands, Nobel chemistry prize 1936), Born (Germany, Nobel physics prize 1954),
Chemical thermodynamics and 3rd law, quantum theory, specific heat
6. de Broglie (France, Nobel physics prize 1927) Wave for quantum theory, Schrodinger (Germany, 1926, Nobel physics prize 1933) wave equation of quantum mechanics, Dirac (Switzerland) for relativistic equation predicting antimatter
7. Onsager (Norway, Nobel prize in Chemistry 1968) Irreversible thermodynamics, phase transitions in two dimensions
8. Landau (Azerbaijan 1937, Nobel physics prize 1962) Theory of phase transitions and of superfluid of helium 4
9. de Gennes (France, Nobel physics prize 1991) Superconductivity, magnetism, liquid crystals, Wilson renormalization group theory for polymers (see below)
10. Widom (USA, 1965) Scaling theory of critical phase transitions, interfaces, surface tension
11. Wilson (USA, Nobel physics prize 1982) Renormalization group theory of critical phase transitions, Widom scaling (see #10 above), and universality
12. Kosterlitz, Haldane, and Thouless (England) (Nobel physics prize 2016) New topological phases and transitions in two dimensional systems
13. Bednorz and Mueller (Switzerland, Nobel physics prize 1987) experimental discovery of high-critical temperature superconductivity
14. Wertheim (USA), Gallavotti (Italy), Robert (Switzerland) (1963, 1976, 1984) Statistical mechanics of classical, continuous, or lattice fluids;

spontaneous symmetry breaking of interfaces in two-dimensional lattice systems and in continuous systems below three dimensions

15. Bloch (Switzerland , Nobel physics prize 1952) experimental discovery of nuclear magnetic induction

16. Binnig and Rohrer (Switzerland, Nobel physics prize 1986) experimental discovery of scanning tunneling microscopy

17. Aris and Amundsen (USA 1954) Process control, nonlinear chemical reactor

18. Dubochet et al. (Switzerland, Nobel chemistry prize 2017), experimental discovery of cryo-electron microscopy

19. Pauli (Austria, Nobel physics prize 1945) discovery and theory of exclusion principle

20. Guillaume (Switzerland, Nobel prize in physics 1920) discovery of abnormal (absent) thermal expansion of nickel-iron alloys